modified. The absolute values of the brightness M, expressed in [star] magnitudes per degree square, have been determined with reference to Vega $0^m.14$ as unity.[6]

TABLE 4.—*Brightness of the zenithal sky*

$h_\odot$	$-7°$	$-9°$	$-11°$	$-13°$	$-15°$	$-16°$
M	$-3^m.0$	$-1^m.35$	$+0^m.25$	$+1^m.80$	$+3^m.10$	$+3^m.65$
$h_\odot$	$-17°$	$-18°$	$-20°$	$-25°$ to $-29°$	----------	----------
M	$+4^m.00$	$+4^m.10$	$+4^m.20$	$+4^m.27$	----------	----------

Beyond $h_\odot = -18°$, the brightness remains virtually constant, the brightness found agreeing with those of the nocturnal sky. Since they were obtained very close to the plane of the Milky Way, in the constellation Cygnus, they are doubtless a little too large.

It is clear that the end of twilight at the zenith coincides with the setting of the second twilight arch, at $h_\odot = -17° 50'$. Hence the two phenomena are related. The twilight arch diffuses the direct light of the sun a first time; this is then reflected once again by the atmosphere of the zenith.

In support of this explanation we may cite the parallelism, without any abscissal lag (décalage d'abscisse), between the curve found by us for the zenith and that which has been obtained by Fessenkopf for 70° zenith distance in the azimuth of the sun.

[6] Superior *m* as here used stands for star magnitudes, expressed decimally.

NOTES, ABSTRACTS, AND REVIEWS

George Titus Todd, 1866-1924

George T. Todd, meteorologist, died at Albany, N. Y., on November 12, 1924. His death was due to a sudden attack of acute dilation of the heart and occurred within 12 hours after he had delivered a lecture on the weather at the Mount Ida Memorial Presbyterian Church at Troy, N. Y.

Mr. Todd entered the Signal Corps on January 4, 1887, and after the usual preliminary course of instruction was assigned as a clerk at the central office at Washington, D. C., and afterwards as assistant at Detroit and Port Huron, Mich., and Memphis, Tenn. He was in charge of the station at Dodge City, Kans., from February, 1890, until November, 1902; at Wichita, Kans., from November, 1902, until May 3, 1905; and at Albany, N. Y., from May, 1905, until the time of his death.

Mr. Todd served the country continuously for 38 years with credit to himself and the Weather Bureau, and with great benefit to those for whom he especially labored. He was a very efficient member of our organization, faithful, conscientious, and courteous in all his undertakings and associations, and an honored and respected member of the communities in which he served. He was not only a Federal official; he was a citizen of the communities in which he lived. He devoted much of his time to them, and their interests were his interests.

In Albany Mr. Todd's skill and judgment in handling the complex flood problems in the spring, the heavy snows and cold waves of winter long ago made his name a household word throughout eastern New York, and his genius in these respects was the means of saving many millions of dollars to the business interests of that congested district.

Mr. Todd left a wife, a son, a daughter-in-law, and a grandson. He was a member of the Masonic fraternity and he was also a prominent member of the Rotary Club of Albany. Perhaps his most distinctive personal characteristics were his unfailing optimism and cheerfulness. These were never wanting, whether he was engaged in forecasting a flood, in cultivating roses, perhaps his best loved diversion, or in promoting the welfare of his fellow man. His associates in the Weather Bureau and the people of Albany and vicinity will hold his name in affectionate memory. (H. C. F.)

GRASSLAND AS A SOURCE OF RAINFALL [1]

551.578.1 F. E. CLEMENTS

In the endeavor to secure a definite correlation between grassland and rainfall, the various associations, such as true prairie, mixed prairie, etc., have been used as indicators of the amount of precipitation. It has been assumed that typical grassland develops only under summer rainfall, but this is incorrect, as the bunch-grass prairie of the Pacific coast corresponds to a winter rainfall, and the desert plains of the Southwest to a two-season or a summer-winter rainfall. In short, the amount of precipitation and evaporation rather than their calendar occurrence, seem to be the controlling factors.

The fact that a plant may transpire more water than a water body of equal surface evaporates, led to experiments to measure the transpiration of representative prairie communities. This was done by incasing sods in 3-foot cylinders without disturbing the roots and weighing these at the desired intervals in the true prarie, mixed prairie and short-grass plains, with annual mean rainfall, respectively, of 28, 23, and 17 inches. It was found that the transpiration in each community was more than equal to the precipitation occurring on it during a year. At Lincoln in the true prairie and Phillipsburg in the mixed prairie the transpiration was about 60 inches for the six-month growing season. This was approximately twice the mean rainfall and somewhat less than twice the evaporation from a free water surface. At Burlington in the short-grass plains, the transpiration for the four-month season was 40 inches or about twice the rainfall and somewhat less than the evaporation.

The cereal crops were found to transpire at about the same rate as the native grasses, while alfalfa lost somewhat more water. The water-loss from the native wheatgrass nearly equaled that from millet, while at Phillipsburg the loss from grama and from oats was the same, with bluestem transpiring nearly twice as much. The loss from alfalfa at Lincoln was about a third greater than that from bluestem. The results explain why ordinary settlement and cultivation have not increased rainfall, but suggest that afforestation over wide stretches would do so.

[1] Read at meeting of American Meteorological Society, Leland Stanford University, June 26, 1924.